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Text of an article:

Comments on the Exercises of Anti-Aircraft
Defence Troops, Code Name: "Tarcza" ["Shield"], by
Lt. Col. M. ZAKRZEWSKI

Exercise "Tarcza" has demonstrated the necessity and the effectiveness of using new Anti-aircraft Defence resources. Also fully justified were the directives of the Command of A.A. Defence Troops on the need to create A.A. Defence groups as temporary tactical formations composed of various A.A. Defence resources for different combat employment, earmarked to carry out one task in a specified place and time.

2. During the exercise could be observed the creation of A.A. Defence groups composed of A.A. artillery sub-units and sub-units for jamming enemy radar bombsights. These groups defended many targets typical for them such as crossings and bridges across wide water obstacles, traffic bottlenecks, unloading stations, etc. The use of A.A. Defence groups composed as described above, strengthened the A.A. Defence of the targets. In addition to engaging the enemy by artillery fire, there was a possibility of jamming his radar bombsights, which eliminated the possibility of the enemy using them.

3. Although most of the decisions made by those taking part in the exercises were right, as far as the use of the A.A. Defence groups composed of A.A. artillery sub-units and sub-units for jamming enemy radar bombsights was concerned, a certain tendency could be noticed in those taking part in the exercise to attach importance to such targets as concentrations of tactical and operational missiles and command posts of operational formations. These targets were not typical for the use, in their defence, of sub-units for jamming enemy radar bombsights, and by the same token, for the use of the A.A. Defence groups mentioned above. In most cases they were located on ground which guaranteed both optical and anti-radar camouflage.

Therefore,

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Therefore, the use of sub-units for jamming radar bombsights was not necessary. The above targets cover a large surface area of 20 to 30 square kilometres, due to the need for dispersal. Protection of such wide areas by sub-units for jamming radar bombsights requires considerable forces and resources, at least a battalion for jamming radar bombsights, which, in comparison with its effectiveness, would not be worth while. Owing to their special features, these targets are not typical radar targets, and their echoes are not likely to be visible on radar bombsight indicators. Even assuming that the airborne enemy will succeed in detecting (observing) them on the radar bombsight indicator, he will have immense difficulties in identifying them on the field of combat.

4. The combat activities of A.A. missile units were organised in most cases independently in spite of the fact that they were covering, in many cases, the same targets as A.A. artillery or sub-units for jamming enemy radar bombsights. It appears that those taking part in the exercises rightly considered that the use of various A.A. Defence resources for the defence of the same targets is right and necessary, because it increases its effectiveness. However, a fundamental fact escaped their attention, namely that at the same place and time the main aim of a battle must be achieved by one commander. It is true that in many cases co-operation was carried out between the A.A. missile units and other A.A. Defence resources covering the same targets, consisting of the exchange of representatives. It seems, however, that this method would not pass the test on the battlefield. It is possible to use this method when two or more units are carrying out the same task in a very short time.

5. It appears that the commands of A.A. Defence operational formations (Army and Front) should have in reserve staffs which, in the event of using large forces and resources for the defence of any particular target, would be in a position to organise the operations of these forces and to direct their combat activities. In the event of carrying out a task with a

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smaller number of resources, for instance with a regiment of A.A. missiles and a battalion for jamming enemy radar bombsights, the command of the whole could be taken by the commander of one of the units (for instance the commander of the A.A. missile regiment).

6. In order to substantiate the necessity of this detaching of separate staffs from the level of the commands of A.A. Defence operational formations, the following should be stated.

7. The commanders and the staff officers of particular units (tactical formations) - although they have a general military education in anti-aircraft defence, are much better acquainted with the specific characteristics of the particular units in which they serve at present because of the nature of the unit (tactical formation). They are less acquainted with the problems connected with the use and operations of special A.A. Defence units. Therefore, when various units of a special character come under command, an unprepared staff runs up against serious difficulties in organising combat operations. In addition, the exercises proved that commanders and staffs are so much absorbed by the organisation and conduct of the combat operations of their organically subordinate units, that they are, in practice, in no position to command the units which are temporarily subordinated to them. Inter alia, the proliferation of technical equipment of particular units, the rapid tempo of operations and consequent difficulties in supply, etc. have a bearing on this. This problem is - where to find such staffs?

8. The above exercise has shown that there is little point in having A.A. artillery divisional staffs under combat conditions. I am not considering the necessity for their existence in peace time conditions. But in combat conditions, when frequently each of the regiments belonging to the division operates in a different area, the divisional staff is unable to direct their combat operations and supply. The exercise proved that divisional commanders often have difficulties in determining the present / position

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13. The exercise gave many interesting solutions in organising / protection of

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protection of targets covering a large surface area by relatively small forces. In these circumstances, a departure was made from the circular grouping of jamming stations around the target, in favour of line grouping by companies. Each company protected the target from two opposite directions. For instance one company protected the East and West direction, and the other one - the North and South direction. As a result, the target in question had circular protection in spite of the jamming resources being deployed directionally. In view of the fairly considerable lengths of the dead area radii of the jamming stations, those taking part in the exercises came to the conclusion that in favourable conditions most of the jamming stations should be located in the opposite direction to the main direction of the enemy air attacks, and the jamming should be sent across the protected target. The exercise has also proved the possibility of linking the tasks of several radar bombsight jamming companies operating next to each other.

14. The exercise supplied a basis for analysis and scientific work in the sphere of planning A.A. defence of troops and fixed targets in conditions of a rapid tempo of operations. It appears that organic engineer and chemical units (sub-units) should form part of the A.A. Defence troops to carry out, inter alia, optical and the anti-radar camouflage of targets. The units hitherto forming part of the A.A. Defence troops viz: A.A. missile units, A.A. artillery units, and the radar bombsight jamming units can be interfered with and have a limited range of action against the enemy. As a result of this, the enemy, in many cases, has the possibility of gaining the advantage over the resources protecting given targets. However, the range of camouflage resources is equal to the range of detection by the enemy, and also the use of camouflage in the complex of other forms of action against the airborne enemy (artillery fire and radar bombsights jamming) can considerably enhance the effectiveness of the protection of

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targets. These resources cannot be interfered with, and are difficult to destroy owing to the small size of the equipment. Equipment used for camouflage is simple and can also be made under field conditions. The production cost of this equipment is much lower than the cost of missiles or artillery, therefore we can afford to have in stock large quantities of it.

15. Camouflage resources act upon enemy reconnaissance resources by concealing or simulating the points of the sight. For instance with the aid of reflecting horns it is possible to simulate or to conceal small targets from radar observation, or else to distort and partly camouflage large objects. Reflecting horns are used also for simulating landmarks used for navigation and bombing. They can also attract guided missiles at the final phase of their flight, by the active homing method.

16. In the age of guided missiles (of the air-ground type), when the carrier aircraft has no need to enter the fire zone of anti-aircraft rockets, and the A.A. artillery defending a given target, as it is equipped with radar bombsights, and can carry out its task out of firing range, the importance of anti-radar camouflage has grown considerably. Camouflage resources together with the Fighter Airforce, are in this case the only resources which can be used against the enemy. However, anti-radar camouflage does not solve the problem entirely, and its effect, as far as hampering accurate observation of a target, can be compared with the effects on radar bombsights of jamming used by radar bombsight jamming sub-units. In these cases total freedom in using optical bombsights is left to the enemy. It should be mentioned that he will use them above all at short distances from the target, because bombing with them is more accurate.

17. The enemy can use optical means of aiming not only in the day time with good visibility, but also at night with artificial illumination of the target. He can also use inaccurate camouflage of lighting and, during cloudless nights, also moonlight and reflections from areas of water,

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(rivers). In order to prevent the enemy using optical instruments for navigation and bombing it is necessary to apply optical camouflage not only to real objects, but also to dummies and anti-radar camouflage resources. The easiest way of camouflaging these objects is by the use of smoke-screens. The exercise revealed a lack of this kind of camouflage, because the jamming of radar bombsights served only as a half-measure, acting exclusively upon the radar bombsights. This deficiency was overcome in the final phase of the exercise, when for the protection of a naval base in addition to a radar bombsights jamming battalion, a smoke-screen battalion was provided.

18. During the exercise under discussion, the principal targets of the Army and the Front were defended by the active A.A. Defence resources during the most important, although relatively short, periods. After carrying out their tasks, these resources followed the attacking troops and proceeded to the defence of the next targets, leaving the formerly defended targets without any protection. It seems that the importance of particular targets is not limited to a specially important period of a given operation. Obviously, in view of their large number and the relatively limited amount of active Defence resources, it is not possible to guarantee them permanent protection by these resources. However, a periodical defence of these targets by an assembly of all the available A.A. Defence resources during the most important periods of the battle, is justified. It appears, however, that during the remaining periods protection for them should be laid on by passive means.

19. Owing to the use of camouflage resources, the enemy will not be able to observe the target and the landmarks and consequently will not be able to aim, or direct flying bombs and air missiles of the air-ground type.

20. A fundamental conclusion from the above is: contemporary anti-aircraft defence of targets located within an army zone of operations should be carried out by an A.A. Defence group composed of all the available current

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ground A.A. Defence resources (A.A. missiles, A.A. artillery, radar bombsights, jamming sub-units, and camouflage sub-units, in co-operation with the Fighter Airforce of the Front). Let us analyse this problem in detail as applied to a target chosen as an example (Diagram 1). Let us assume that the target in question consists of a bridge complex situated across a wide water obstacle. For the anti-aircraft defence of this target were detailed the following ground A.A. Defence resources: a regiment of anti-aircraft missiles, a regiment of small calibre anti-aircraft artillery, two radar bombsight jamming companies, a smoke-screen battalion, and an anti-radar camouflage sub-units equipped with reflecting horns. These forces formed an A.A. Defence group commanded by a command and staff detailed by the headquarters of the operational formation A.A. Defence.

21. The anti-aircraft missile regiment is deployed according to general principles. Its deployment was adapted for the defence of two bridges located within the boundaries of a village, and the third bridge to the South of it is within the range of its fire. The task of this regiment consists of the engagement of medium and high altitude targets.

22. The small calibre anti-aircraft artillery regiment is defending two bridges against low level attacks. In view of their close position, batteries defending individual bridges have fire-control communication.

23. The anti-radar camouflage sub-unit carried out the following camouflage:

- part of the river within the boundaries of the village was camouflaged with the aid of reflecting horns. The railway bridge at the South of the village was brought into the radar area of the target with the aid of the reflecting horns, and the whole village was extended towards the South;
- around the Southern bridge were built from reflecting horns three dummy bridges prepared for carrying out a move. The erection of the dummy bridges in respect of the real bridge,

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can be done in an arbitrary fashion;

- the first company for jamming radar bombsights was deployed in a line of platoons in front of the main target. Individual platoons were also deployed in a line. The combat action of the company was set in the main direction of the enemy air attacks. However, the task of the complete protection of the target was beyond its capability;
- the second company protected the bridge situated to the South of the village. The company was deployed in the form of a triangle. The target was protected from all directions. In addition, it supported the operations of the first company;
- the smoke-screen battalion was used in the following way: two companies were used for covering two bridges with a smoke-screen and the anti-radar camouflage of the main target, the third company covered the third bridge with a smoke-screen.

24. On the basis of the above example, one can estimate the situation in which an enemy bomber crew which has to bomb a definite target finds itself. To get a better idea of the example let us make the following assumptions.

25. The aircraft is flying from the West, and at a long distance from the target the navigator has switched on his radar bombsight in order to find the target. He can see on the screen an outline of the river as a dark line, and also the light colour reflection from the village. However, he does not know that the target has been extended southwards, also he does not see separate echoes from the bridges, he can only see the whole target as a light coloured spot. He hopes that when approaching the target he will distinguish the bombing targets, i.e. the bridges. He looks at the right side of the screen where he expects to see on the reflection from the river a bright reflection from a separate bridge. He is surprised when instead of a single reflection he sees four separate small bright points.

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The dummy bridges were placed at distances exceeding the linear value of the radar bombsight resolution parameter. The navigator now looks at the reflection from the main target of attack and can still see the whole of it. In the meantime, the aircraft has flown over a considerable distance and is approaching the start of the combat route, so that in a moment it will be too late for the use of the radar bombsight. Therefore he casts his eye on the optical bombsight - it is still too far, he cannot see the target. He looks back on the screen - apart from the reflections from the targets he can observe interference, which grows with the approach to the target. He now realises that he will not be able to observe the target as a separate point on the indicator, he must give up using the radar bombsight and go over to target observation through the optical bombsight. But he does not know that active jamming is being used to interfere with his work and for psychological effect. The bomber crew becomes flustered.

26. The first aim of the anti-aircraft defence has been achieved. In a moment the aircraft will enter the fire zone of the anti-aircraft missiles. Should they lose height to avoid being hit? By flying within the range of missiles the aircraft will certainly be brought down. Assuming that the enemy is in possession of jamming resources and radar counter-measures, and that in spite of all he decides to fly across the fire zone of the anti-aircraft missiles. If he loses height, he will meet the fire of the small calibre anti-aircraft artillery regiment. One way or another he must aim. The radar bombsight is of no use.

27. Let us assume that the aircraft keeps flying on, although in all probability it would be brought down by the anti-aircraft missiles. The enemy now intends to use the optical bombsight, but smoke is obscuring the target. One more thought: should the bombs be released blindly? We will leave this decision to the enemy. Should he release the bombs aiming into the smoke-screen, the probability of hitting the bridges is extremely small.

28. As a rule, the start of the combat route is already behind the
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aircraft. Let us assume that the navigator had time to aim with the aid of the radar bombsight and that in spite of the active radar jamming he could observe the southern border of the town on the indicator. He knew that the railway bridge was on the southern border. Therefore, as impulses are coming from the town, it is better to aim at the edge of it than into the vast smoke-screen, which is not symmetrically spread over the target. He aims and releases the bombs which fall to the right of the bridge. The navigator did not know that the reflecting horns extended in this direction the reflections from the target. It is also possible to "help" the enemy in finding the target. For this purpose it is sufficient to simulate the bridge over the river on the southern border of the village with the aid of reflecting horns. This dummy bridge should be shown to him in such a way that he will suppose that its visibility is the result of imperfect camouflage. In this case there is no doubt that he will take advantage of the "favourable" circumstances and will bomb the dummy bridge. Because of the camouflage, the enemy is not able to determine the effect of his bombing. He flies away and is continually exposed to anti-aircraft missile fire. The task of the anti-aircraft defence has been accomplished, irrespective of whether the enemy aircraft has been brought down or not.

29. If the enemy attacks the separately located bridge (to the South of the main target) he sees four identical reflections instead of one, hence he must choose one of the four unknowns. In addition, his radar bombsight is being jammed. The use of the smoke-screen does not allow him to use the optical bombsight. In addition, the target is within the fire zone of the missile artillery.

30. Diagram 1 shows an example of the protection of a target by an A.A. Defence group. There can be many solutions concerning the allotment of forces and resources for the protection of particular targets, as well as concerning their employment. The protective cover of the group of bridges as presented here, is planned well in advance. At a definite stage of

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operations, according to the decision of the Chief of A.A. Defence, the A.A. missile regiment, the A.A. artillery regiment, and two radar bombsights jamming companies will be transferred to perform other tasks. After their departure, for the protection of the target, the smoke-screen battalion and the anti-radar camouflage sub-unit will remain.

31. Camouflaging a target does not, however, entirely solve all the problems connected with aiming. It is known that the modern battlefield will supply the enemy with an additional number of convenient landmarks, and therefore the radar picture of a given sector of terrain will change, and will make more difficult the choice of basic landmarks. Landmarks of any particular kind, such as lakes, should be partly camouflaged in order to change their outline. As a rule, however, the forces available for this purpose are insufficient, as there are relatively many landmarks in the neighbourhood of the target (villages, lakes, etc.).

32. As is known, a bridge is basically a linear target (the width of a bridge is usually small, and is not taken into consideration) and a direct hit is necessary to destroy it. This in turn requires accurate aiming. Aiming with the aid of landmarks, especially landmarks of large dimensions (as compared with the bridge) is difficult, and therefore such landmarks are of not much use when the target is small. Especially valuable for the enemy in this case will be fixed landmarks giving small but distinct and clear echoes on the screen of the radar bombsight. These may be the clear radar objects or the characteristic points located in front of the defended target in the direction of flight. Therefore knowing the particular radar properties of various objects and enemy operational tactics it is possible to select and camouflage some of the large number of landmarks.

33. For the anti-aircraft defence of targets within the zone of operations of an army and on the area of a Front, various alternative methods of using the forces and resources should be applied. The idea is that the

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enemy should continually meet with new difficulties and surprises.

34. I realise that I have discussed only a few selected problems which in my opinion are the most important and which require a wider discussion and analysis among our officer cadre.

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